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## Dark Matter in Gas-Rich Dwarf Galaxies

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**Abstract.** We investigate the distribution of dark matter (DM) in gas-rich, low-mass galaxies, confronting them with numerical cosmological simulations with cold dark matter ( $\Lambda$ CDM). We show that the derived rotation curves comply best with cored DM density profiles, whereas the signatures of the central cusps invariably predicted by  $\Lambda$ CDM simulations are not seen.

### 1. Introduction

Rotation curves of disk galaxies constitute the most powerful tools to study dark matter, its content relative to baryons, and its distribution on the scale of galaxies. In particular, dwarf galaxies are prime candidates for DM studies as their kinematics is generally dominated by dark matter down to small galactocentric radii (Persic et al. 1996). Thus, they provide an important test for cosmological models, because numerical cosmological simulations with CDM predict a common characteristics, a central steep rise (cusp) in the DM density profile (e.g. Navarro, Frenk and White 1996). Following a thorough investigation of a sample of low-luminosity galaxies (Gentile et al. 2004), which clearly documents the problems with central cusps as described above, we have embarked on a study of dwarf galaxies that are gas-rich, isolated and DM dominated.

### 2. The targets

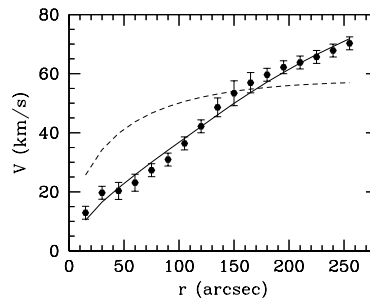
DDO 47 is a dwarf irregular galaxy at 4 Mpc distance. The galaxy has a fairly regular structure. The velocity field of the gas looks regular, rendering this galaxy a convenient object for kinematic studies. NGC 3741 is a dwarf irregular galaxy at 3.5 Mpc distance. The HI observations reveal the largest disk in terms of optical scale length, viz.  $42 \times R_{opt}$ . This allows us to probe the galactic potential out to exceptionally large radii. DDO 154, an extremely gas-rich dwarf galaxy at 3.2 Mpc distance, is known to have a large gaseous disk and a very asymmetric rotation curve, which appears to decline in the outer parts (e.g. Carignan & Purton 1998).

The HI data cubes have been used to thoroughly investigate the kinematics of the galaxies (Gentile et al 2005, 2007). Apart from deriving their rotation curves (s.b.), this also involved a harmonic analysis, such as to uncover non-circular motions and asymmetries in the kinematics of the gaseous disks. In DDO 47, non-circular motions of below  $3 \text{ km s}^{-1}$  were detected, likely connected with the spiral structure. NGC 3741 exhibits non-circular motions of up to  $10 \text{ km s}^{-1}$ , most likely due to a bar in the inner region and to gas inflow in

the outer one. DDO 154 exhibits clear signs of non-circular motions. We have analyzed the data cube with our new tilted-ring fitting code (TiRiFiC, Józsa et al. 2007; see also Józsa et al., these proceedings). Our preliminary 3-D reconstruction of the gaseous disk using TiRiFiC manifests the complex morphology and kinematics, its systemic velocity and centroid varying as a function of radius. The latter could be the signature of recent gas infall, giving rise to an unrelaxed baryonic disk; this is corroborated by the non-circular motions, which can be interpreted in terms of gas infall.

### 3. Rotation curves

We have used the rotation curves of DDO 47 and NGC 3741 to perform a mass decomposition. The resulting circular velocities of the DM halo were compared with models. The Figure shows mass models for DDO 47, with the solid line representing the best-fitting model with a Burkert halo, while the dotted line represents the best-fitting NFW model. It is obvious that the rotation curve of DDO 47 is in conflict with an NFW law, while a Burkert law yields a rather good fit. The kinematic signatures found along the minor axis are too small to wash out any cusp-shaped density profile, thus mimicking a cored DM halo as proposed by Hayashi et al. (2004). The rotation curve of NGC 3741, too, fits the Burkert halo very well, while  $\Lambda$ CDM halo profiles produce worse fits. MoND also delivers acceptable fits. The derivation of the rotation curve of DDO 154 has to await the final analysis with TiRiFiC.



### 4. Conclusions

In summary, it is obvious that the rotation curves of DDO 47 and NGC 3741 are easily reconciled with cored density distributions of their DM halos, while  $\Lambda$ CDM is still facing a serious problem here.

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